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Case Report

Right hepatic vein bullet embolism: A case report

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ABSTRACT

Penetrating trauma is usually divided into stab and gunshot wounds (GSW). When considering GSW, the initial assessment involves the identification of all the wounds, to understand the projectile's trajectory as well as to determine which anatomic structures might have been damaged [1]. Rarely, the projectile might not leave the victim's body and embolize to a different region through large blood vessels. Known as Missile Embolism (ME), this uncommon complication can compromise multiple body segments, resulting in severe injuries, whether it occurs through an artery or a vein, such as pulmonary embolism, cardiac-valve incompetence, limb-threatening ischemia, coronary infarct, and stroke [2,3]. This is a case report of an 18-year-old male patient who suffered a gunshot wound and was submitted to an exploratory laparotomy which identified a laceration of the inferior vena cava. Further exams concluded that the bullet was embolized to the right hepatic vein. ME treatment will depend mostly on the bullet's placement; if located in the left circulation or arterial vessels, retrieval is the preferred treatment. It can be executed through surgical exploration or endovascular procedure [3,4,8] Venous ME has several treatment options, including conservative management if the patient remains asymptomatic [3–7]. Cases of paradoxical embolization might be managed as arterial ME [3,4].

Introduction

Penetrating injury is considered one of the main trauma mechanisms because of its high frequency, being divided into stab and gunshot wounds (GSW). When considering GSW, the initial assessment involves the identification of all the wounds, to understand the projectile's trajectory as well as to determine which anatomic structures might have been damaged [1]. Rarely, the projectile might not leave the victim's body and embolize to a different region through large blood vessels. Known as Missile Embolism (ME), this uncommon complication can compromise multiple body segments, resulting in severe injuries, whether it occurs through an artery or a vein, such as pulmonary embolism, cardiac-valve incompetence, limb-threatening ischemia, coronary infarct, and stroke [2,3].

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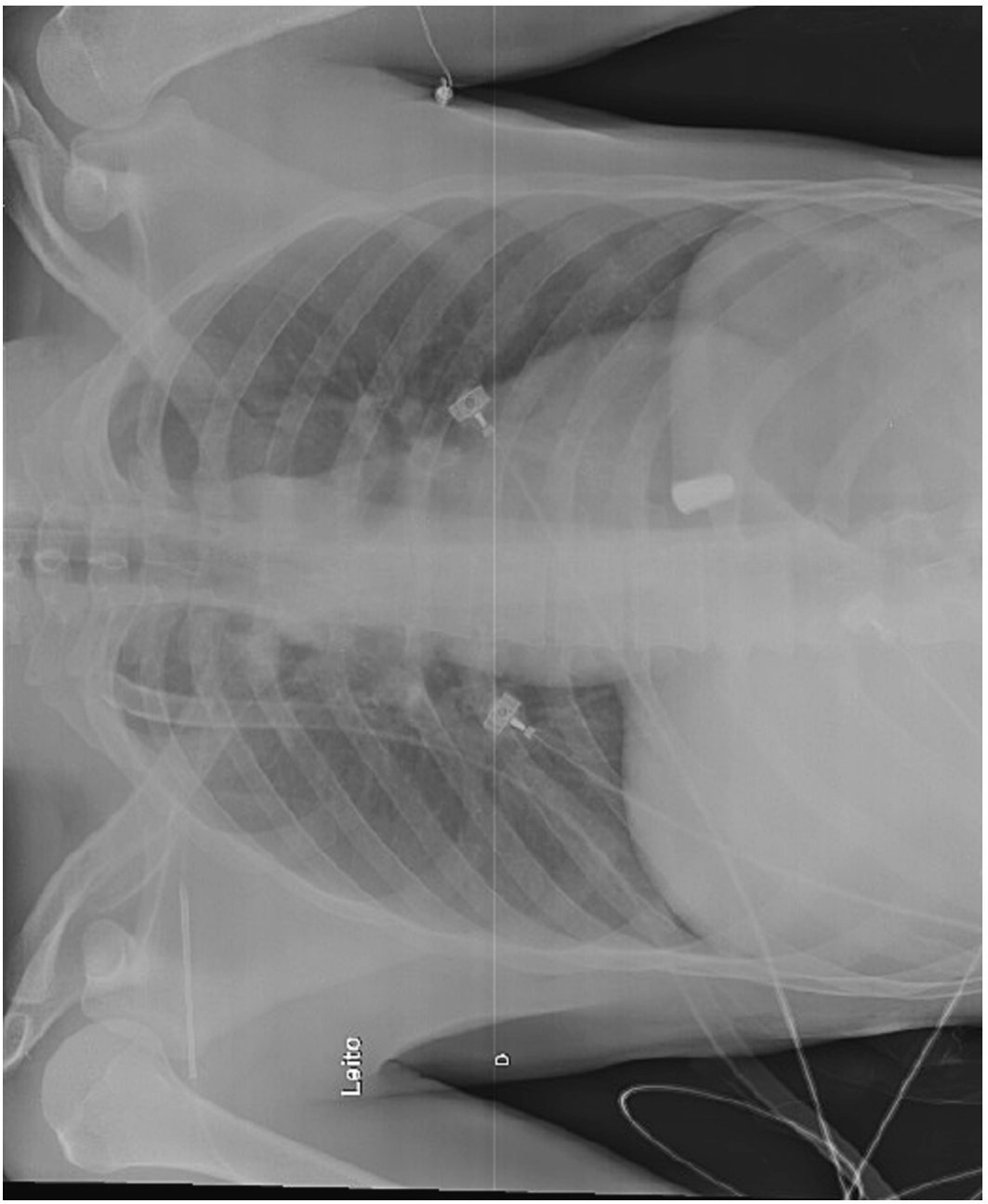

Fig. 1. A portable X-ray showing the location of the projectile in the cardiac silhouette.

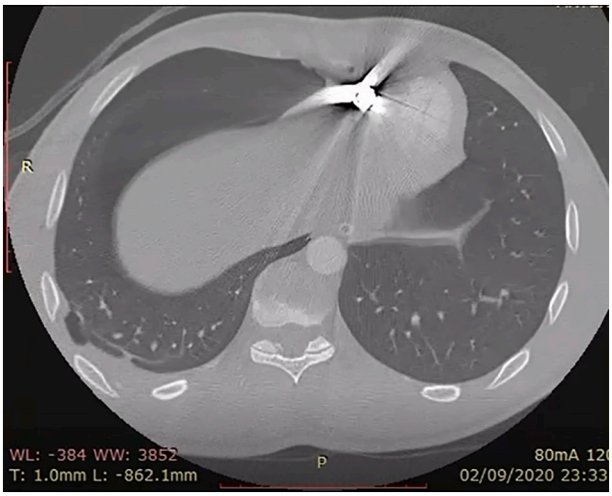

Fig. 2. CT scan (axial view) executed on the first postoperative day showing the location of the projectile.

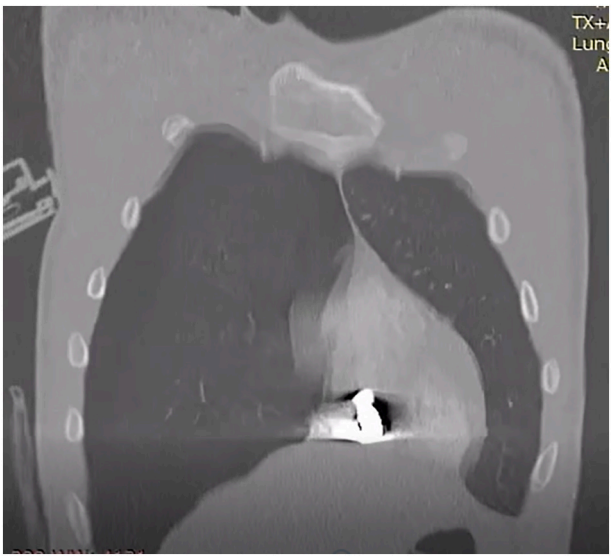

Fig. 3. CT scan (coronal view) executed on the first postoperative day showing the location of the projectile.

Regularly, imaging exams, like computerized tomography (CT) scan and echocardiography, help diagnose the correct location of the projectile and its path [4,5]. Although the literature is limited regarding specific ME treatments, the bullet's location will determine the appropriate management. When located in the left circulation or arterial vessels, retrieval is the preferred treatment. [3,4,8] Early extraction is indicated in all cases involving main arteries supplying the extremities and the internal carotid artery [10]. Even without concurrent ischemia, the missile's removal is still advised, given the risk of a later ischemic event [4]. Venous ME has several treatment options, including conservative management, according to its location and if the patient remains asymptomatic [3–7]. Paradoxical embolization is the least common type of ME, when identified it might be managed as an arterial ME [3,4].

Case report

A previously healthy 18-year-old man was carried to the Emergency Department with a single thoracoabdominal gunshot wound. The response team from a secondary care center had already proceeded with intubation and right tube thoracostomy, evacuating 640 mL of blood. Yet, the patient remained hemodynamically unstable, thus being transferred to a level one trauma center. At admission, it was possible to identify the GSW entry on the right posterior axillary line by the ninth intercostal space (ICS) without the exit wound being noticeable. The first assessment chest X-ray indicated the bullet's location in the cardiac area (See Fig. 1). Given his hemodynamic status, a positive Focused Assessment with Sonography for Trauma (FAST) on the hepatorenal fossa, splenorenal fossa, and

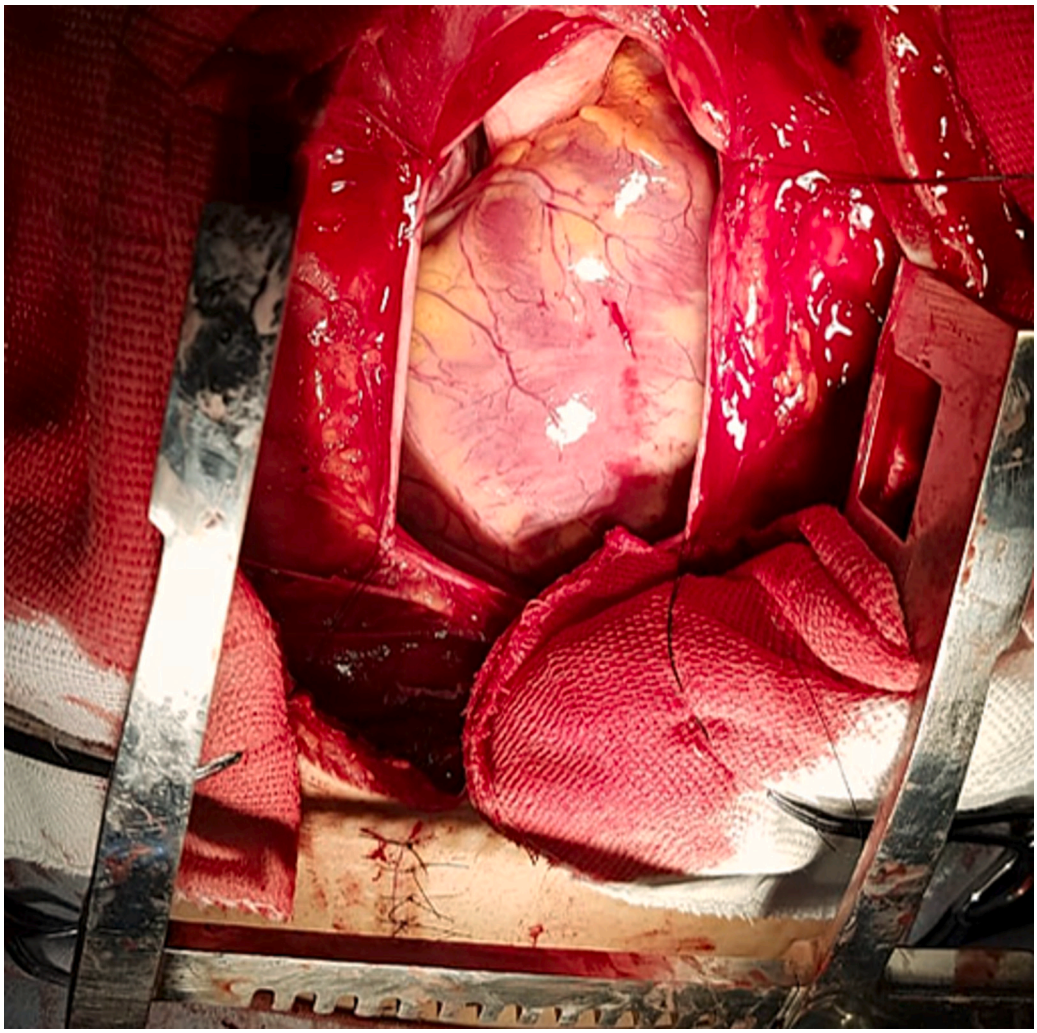

Fig. 4. Intraoperative view of the pericardial cavity exhibiting the integrity of the visceral pericardium.

pelvis indicated immediate transference to the operating room for an exploratory laparotomy.

Intraoperative findings demonstrated liver injury, a right diaphragmatic tear, and an inferior vena cava (IVC) laceration near the duodenum with active bleeding. Controlling the bleeding enabled the diaphragm and IVC to be sutured. Despite exploring, no evidence of a projectile inside the abdominal cavity was found, and the patient was closed and transferred to the intensive care unit (ICU). On the first postoperative day, the patient underwent a CT scan, and the 9 mm projectile was identified near the diaphragm in significant contact with the inferior cardiac margin (See Figs. 2 and 3). In addition, a transthoracic echocardiogram (TTE) showed a foreign body in the right ventricle possibly embedded in the myocardium associated with a small pericardial effusion.

Given the image findings, the patient was submitted to an exploratory sternotomy, yet nothing was found inside the pericardial sac or chest cavity (See Fig. 4). Attempting to confirm those findings, intraoperative echocardiogram, and fluoroscopy did not identify the missile in the heart chambers. However, due to fluoroscopy identification of the missile in the abdominal cavity (See Fig. 5), a second-look laparotomy was performed. In reviewing the first procedure, there was no intra-abdominal bleeding or IVC leaks, whereas the location of the missile was still unknown. Furthermore, an intraoperative ultrasound noticed the foreign body lodged in the right hepatic vein. Due to the high-risk area, the team opted to manage it conservatively.

Although the postoperative course was complicated by acute pericarditis requiring an open pericardial drainage, the patient recovered without further complications. He was discharged four weeks later with regular measures of lead levels, and during his three-years follow-up, he remained asymptomatic (See Fig. 6). A control CT scan revealed the projectile remained in the same location as observed during discharge.

Discussion

ME is a rare complication of gunshot wounds [3,4,6,7]. Previously reported cases showed that these events are more likely to

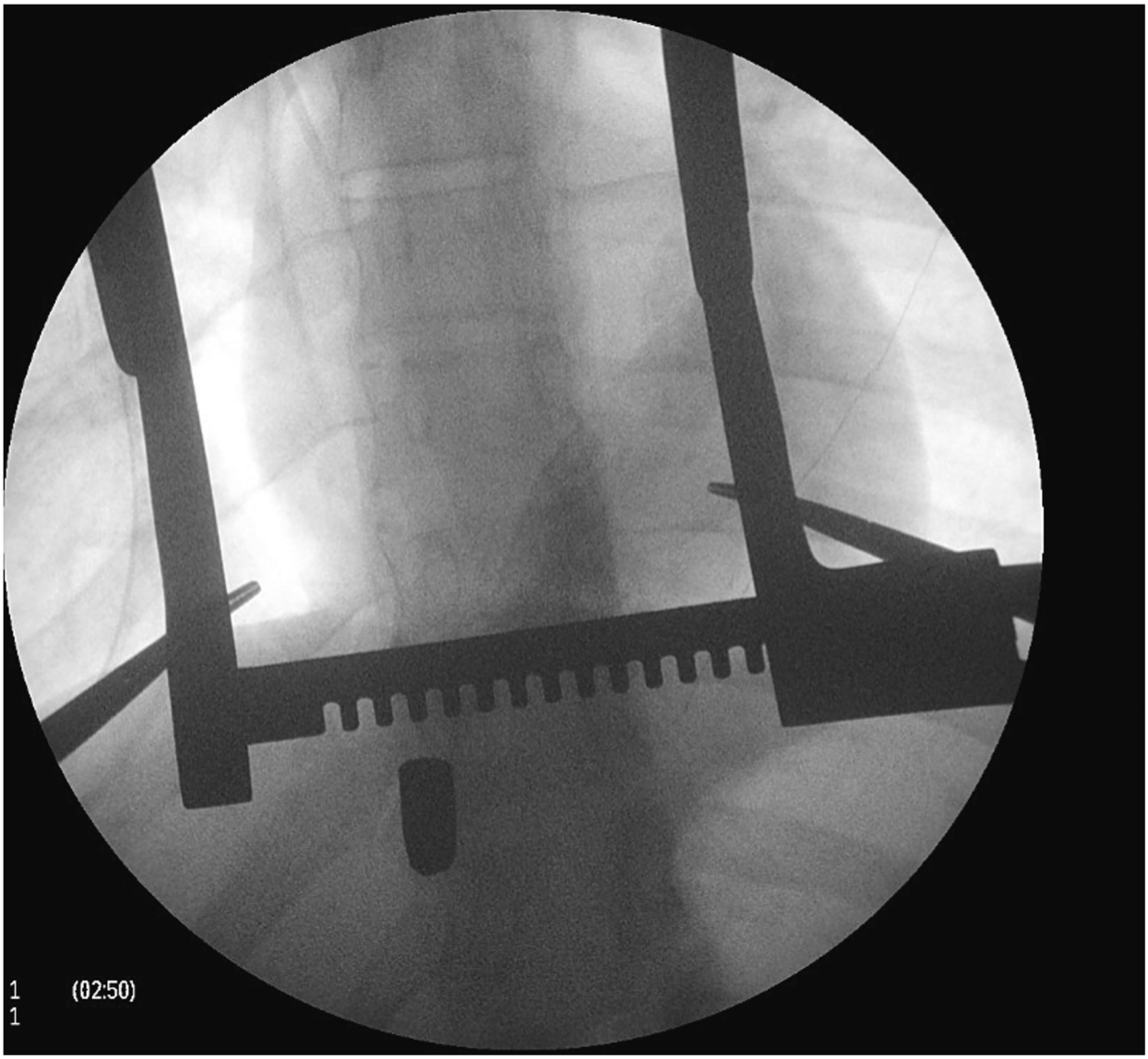

Fig. 5. Intraoperative fluoroscopy showing the caudal position of the bullet.

happen with small-caliber and low-velocity missiles [5]. These projectiles possess limited kinetic energy, enabling them to enter soft tissue, and in some cases traverse just one side of a vessel wall, subsequently being carried along by the bloodstream [5,6]. Regarding the vascular system, the bullet's entrance site happens more commonly through the large-caliber vessels (e.g., aorta and IVC) or the left ventricle. Typically, ME tends to occur in males between the ages of 20 and 40 [4]. ME classification is determined from its entrance site into the vascular system and its route: arterial, venous, or paradoxical [2,3,8]. Despite the classification, any ME type can cause substantial morbidity and mortality [3]. There is conflicting data in the literature regarding arterial and venous ME incidence, with more recent statistics favoring venous ME over arterial [3,7]. When in the venous system, the bullet's migration is mainly affected by the force of blood flow and the missile size, as well as velocity, gravity, body position, and respiratory movement [11]. Symptoms differ according to the embolus location and the vascular segment compromised: ME in the left circulation is more commonly symptomatic, yielding ischemia to the limbs or organs such as kidneys or coronary vessels, and cerebrovascular incident [4]. When the right circulation is affected, most patients will remain asymptomatic [4]. Nevertheless, it still may cause severe complications, including cardiac valvular damage and endocarditis [2].

Missile embolism diagnosis is challenging and requires a high index of suspicion, especially when the entrance of a gunshot wound is noticed without an exit one [4–6,8] or in cases where the bullet's position, identified by a radiograph, does not match its expected trajectory [5,8]. A thorough physical exam must proceed; since locating the projectile's precise position becomes the priority [3,4]. For its diagnosis, surgeons should consider an incongruent number of gunshots; a radiograph showing the bullet outside its expected trajectory, and serial radiographs exposing the moving foreign body [9]. As in the presented case, radiography is the initial exam for

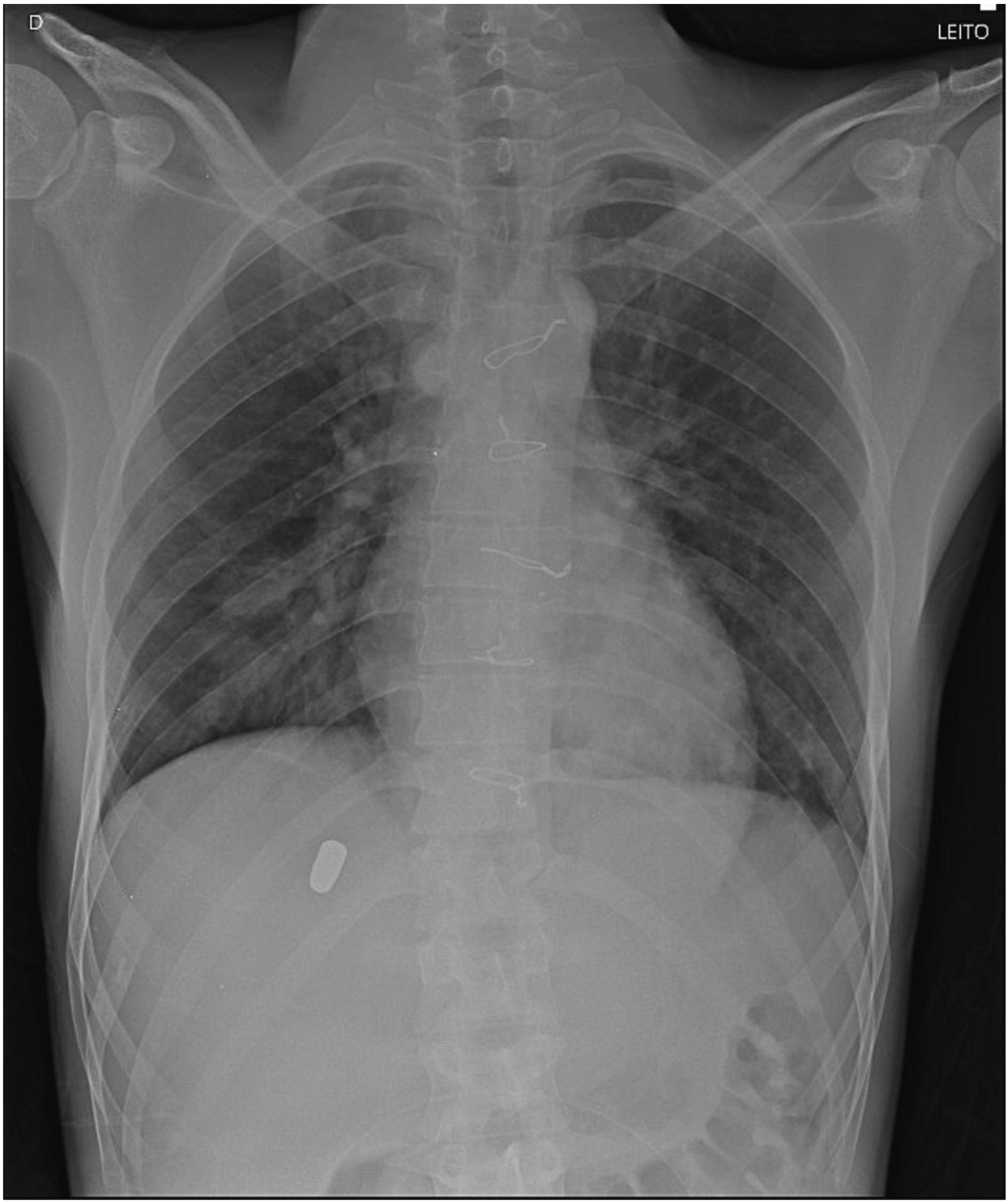

Fig. 6. X-ray executed three years after the trauma showing the location of the projectile in the liver position.

investigation, followed by CT; although the foreign body may cause interference, it still carries diagnostic value [5,6,8]. Other diagnosis images include TTE, transesophageal echocardiogram (TEE), and angiocardiography that determine the management plan [5,6].

ME treatment will depend mostly on the bullet's placement. To retrieve the bullet is the preferred treatment in cases where the

projectile is located in the left circulation or arterial vessels. [3,4,8] The embolectomy can be performed through an endovascular procedure or surgical exploration [2–4,7]. The first one presents a high success index in most cases and also fewer complications [3,4]. The extraction is indicated in all cases involving main arteries supplying the extremities and the internal carotid artery [10]. Besides that, even when there are no ischemia, the risk of a future ischemic event makes the missile's removal advisable [4].

When considering venous ME treatment, there are a few possibilities, ranging from operative to conservative options. Having that in mind, the choice will depend on the bullet's location and if the patient remains asymptomatic [3–7]. When the embolus is inside the right ventricle, even in asymptomatic patients, some authors advise its retrieval due to the risk of embolization into the pulmonary artery, which has a high mortality rate [5,7]. Symptomatic patients with right circulation embolus warrant consideration of removal, with endovascular retrieval being the preferred approach [4].

The least common type is a paradoxical embolization when the missile enters the right-side circulation and travels to the left-side circulation through a cross-circulation shunt. Considering this diagnosis in venous ME cases, additional imaging is necessary to rule out cardiac shunt [4]. If confirmed, it might be managed as an arterial ME [3,4]. Further indications of surgical intervention include irregularly shaped or bigger than five millimeters missiles, left-sided intracavitary, partially embedded missiles, or located close to an artery [6].

Accordingly, ME is an uncommon complication of gunshot wounds, particularly suspected when the amount of entry wounds differs from exit wounds. The surgical team must readily recognize its possibility and identify the missile's position. Both endovascular and open-surgery retrieval have high success rates. Conservative treatment is an option for specific situations.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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